

2008 BUILDING ENERGY EFFICIENCY STANDARDS

CALIFORNIA
ENERGY
COMMISSION

COMMISSION MANUAL



RESIDENTIAL COMPLIANCE MANUAL

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**2008 Second Quarter Revision Summary of Pages for
Residential Compliance Manual**
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SUMMARY OF CHANGE	CHAPTER/FORM	PAGE	PAGES REPLACED
Updated Table of Contents	TOC	viii	vii, viii
In Table 1-2, clarification on garages, carports, sheds, and agricultural buildings; Note on U occupancies	Introduction	1-9	1-9, 10
More detailed examples of vapor barrier	3.6	3-67, 68	3-67, 68
Delete text "that requires the removal of the cover plate" on first paragraph after ASHRAE box	4.6.2	4-55	4-55, 56
Add new section 4.6.7 Minimum Best Practice Guide: Exhaust-Only Ventilation.	4.6.7	4-76	4-75, 76
Add new Appendix 4A Minimum Best Practice Guide: Exhaust-Only Ventilation to end of the Chapter	Appendix 4A		Insert Appendix 4A to end of Chapter 4
Additional language on Standard Charge Measurement Procedure at 3rd bullet	CF-4R-MECH-25	2 of 5	2 of 5
	CF-6R-MECH-25-HERS		
Under Block 2, New HVAC system, change MECH-21 reference to MECH-20	CF-1R-ALT-HVAC CZ 2 and 9	All	All
	CF-1R-ALT-HVAC CZ 10 - 15		
	CF-1R-ALT-HVAC CZ 16		

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Table 1-2 – Building Types Covered by the Low-Rise Residential and Nonresidential Standards

Low-Rise Residential Standards (covered in this compliance manual)	Nonresidential Standards (covered by Nonresidential Compliance Manual)
All low-rise residential occupancies including single family homes, duplexes, garden apartments and other housing types with three or fewer habitable stories.	All nonresidential CBC occupancies (Group A, B, E, F, H, M, S, or U), as well as high-rise residential (Groups R-1 and R-2 with four or more habitable stories), and all hotel and motel occupancies. Note: U occupancies may be either Residential or Nonresidential.
<p>Includes:</p> <ul style="list-style-type: none"> • All single family dwellings of any number of stories (Group R-3) • All duplex (two-dwelling) buildings of any number of stories (Group R-3) • All multifamily buildings with three or fewer habitable stories (Groups R-1 and R-2) • Additions and alterations to all of the above buildings. • Lighting requirements for living quarters in high-rise multifamily buildings (over 3 stories) and water heating requirements for high rise multifamily buildings (over 3 stories) 	<p>Includes:</p> <ul style="list-style-type: none"> • Offices • Retail and wholesale stores • Grocery stores • Restaurants • Assembly and conference areas • Industrial work buildings • Commercial or industrial storage • Schools and churches • Theaters • Hotels and motels • Apartment and multifamily buildings with four or more habitable stories (envelope and HVAC requirements in all areas; and lighting in common areas) • Long-term care facilities (group R-2) with four or more habitable stories • Dormitories or other congregate residences, or any building with dormitory-style sleeping quarters, with six or more “guest rooms” • Residential garages for 8 or more vehicles • Residential carports and parking lots for 8 or more vehicles per site • Sheds greater than 1000 square feet • Agricultural buildings greater than 2500 square feet

1.5.2 Historical Buildings

Exception 1 to §100(a)

Exception 1 to §100(a) states that qualified historic buildings, as regulated in the California Historical Building Code Title 24, Part 8 or California Building Code, Title 24, Part 2, Volume I, Chapter 34, Division II are not covered by the Building Energy Efficiency Standards. §146 (a) 3 clarifies that lighting systems in qualified historic buildings are exempt from the lighting power allowances only if they consist solely of historic lighting components or replicas of historic lighting components. If lighting systems in qualified historic buildings contain some historic lighting components or replicas of historic components, combined with other lighting components, only those historic or historic replica components are exempt. All other lighting systems in qualified historic buildings must comply with the Building Energy Efficiency Standards.

The California Historical Building Code (CHBC) Section 102.1.1 specifies that all non-historical additions must comply with the regular code for new construction, including the Building Energy Efficiency Standards. CHBC Section 901.5 specifies that when new or replacement mechanical, plumbing, and electrical (including lighting) equipment or appliances are added to historic buildings they should comply with the Building Energy Efficiency Standards, including the Appliance Efficiency Regulations.

The California State Historical Building Safety Board has final authority in interpreting the requirements of the CHBC and determining to what extent the requirements of the Building Energy Efficiency Standards apply to new and replacement equipment and other alterations to qualified historic buildings. It should be noted that in enacting the State Historical Building Code legislation, one of the intents of the Legislature was to encourage energy conservation in alterations to historic buildings (Health and Safety Code Section 18951).

Additional information about the CHBC can be found on the following web site:

<http://www.dsa.dgs.ca.gov/SHBSB/default.htm>

Or, contact the SHBSB at (916) 445-7627.

Example 1-1

Question

Are additions to historical buildings also exempt?



Answer

If the addition adjoins the qualified historic building, then the enforcement agency at his discretion may exempt those measures, which he determines could damage the historic value of the building. However, “additions which are structurally separated” from the historical building are not exempt from the Energy Efficiency Standards and must comply with building codes including Historical Building Code, Title 24, Part 8, Section 8-704.

Example 1-2

Question

A sunspace addition is designed with no mechanical heating or cooling and a glass sliding door separating it from all existing conditioned space. Under what conditions will the Standards not apply to this addition?

below 1.5, combustion and solid-fuel burning appliances must be provided with adequate combustion and ventilation air from outside the structure in accordance with the requirements of ASHRAE Standard 62.2 Section 6.4.

Refer to Chapter 4 Section 6 of this manual for information about the ASHRAE Standard 62.2 requirements. Section 4.6.5 provides information about the requirements for Combustion and Solid-fuel Burning Appliances.

3.6 Vapor Barriers and Moisture Protection

A vapor barrier or retarder is a special covering over framing and insulation that helps protect the building envelope components from possible damage due to moisture condensation. During cold weather, the inside of the house is warm and moist (from breathing, showers, and cooking, etc.) and the outside is cold and dry. Moisture laden air will move from more pressure to areas of less pressure in a home and find its way through warmer surfaces to colder ones. When water vapor reaches a point in the wall or roof assembly that has a temperature below the dew point, it will condense. This water build up can cause structural damage, create mold that may contribute to indoor air quality problems and can cause the insulation to lose its effectiveness. Vapor barriers can be a valuable asset to a home's durability in all climate zones.

3.6.1 Mandatory Measures

§150(g) Reference Residential Appendix RA4.5.2

In climate zones 14 and 16, a vapor barrier must be installed on the conditioned space side of all insulation in all exterior walls, on the floors of unvented attics, and on floors over unvented crawl spaces to protect against moisture condensation.

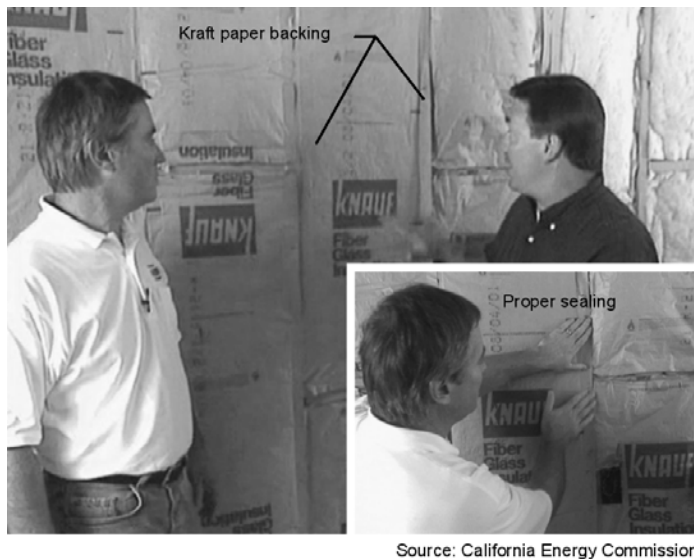
If a building has a controlled ventilation crawl space (see Section 3.3.7), a vapor barrier must be placed over the earth floor of the crawl space to reduce moisture entry and protect insulation from condensation in accordance with Reference Residential Appendix RA4.5.2.

The Standards define a vapor barrier as a material with a permance of one perm or less. The performance test for vapor barriers or retarders is ASTM E96. A perm is a measure of resistance to the transmission of water vapor and is equal to the number of grains of water vapor (7000 grains = 1 lb.) that passes through 1 sq ft. of the material in 1 hour when the vapor pressure differential between two sides of the material equals 1 inch of mercury pressure (0.49 psi). For all types of vapor barriers, care should be taken to seal and repair any tears and penetrations through the material, such as electric outlets, protruding plumbing on exterior walls, and around recessed lighting fixtures on the roof ceiling.

Examples of commonly used vapor barrier/retarder materials recognized by the Energy Commission are:

- Interior paint provided the paint product's performance and testing information shows its conformance to ASTM E96 as a vapor retarder and it is applied to the correct thickness (mil) in the field.
 - Installation: Vapor retarder paints must show proof of compliance to ASTM E96 either on the can or in the product's specification/data sheet and applied to the manufacturer's specified thickness (mil) to achieve the perm rating.
- Sheet membrane material such as 4-6 mil polyethylene or other similar tested material.
 - Installation: Membrane materials are typically installed in a continuous fashion across the plane of the framing surface with staples or glue as the fastening agent.
- Kraft-faced type insulation batts which are produced in two forms: with side fastening flanges, and without side fastening flanges. Kraft-faced batts must be installed such that the facing material is in substantial contact with the finished wall material, such as gypsum board, per Chapter 7 of the CBC.

- Installation: Batt insulation must fill the entire cavity with little to no compression, side-to-side and top-to-bottom. Faced batts with flanges can be installed by: (1) fastening the flange across the face edge of the framing (i.e., face stapling; see Figure 3-28), (2) side stapling of the flange to the inside edge of the framing ensuring the edge of the flange is even with the face of the framing, or (3) friction fitting of the batt with no fastening of the flanges. Faced batts without fastening flanges are friction-fitted into framing cavities. Also see Wall Insulation in Reference Residential Appendix RA3.5 and RA3.5.4 for further insulation procedures.
- Encapsulated fiberglass or other insulation encapsulated in a poly-type material where one or more surfaces of the encapsulation material has been tested and complies with the vapor barrier/retarder requirements.
 - Installation: Encapsulated insulation products may or may not incorporate fastening flanges. Their installation is the same as for faced batt insulation products.
- Faced gyp/wallboard where the facing meets the vapor retarder requirements.
 - Installation: The faced side of the gyp/wallboard is to the inside of the framing against the cavity insulation material.



Source: California Energy Commission

Figure 3-28 – Vapor Barriers with Kraft Paper

3.7 Roofing Products (Cool Roof)

Roofing products with high solar reflectance and thermal emittance are referred to as “cool roof”, which is the outer layer or exterior surface of a roof. As the term implies, the temperature of a cool roof is lower on hot sunny days than for a conventional roof, reducing cooling loads and the energy required to provide air conditioning. Compliance credit may be taken when a cool roof is installed when using the performance approach. The credit is available only if there is no radiant barrier installed. In the performance method calculations, the cooling benefit of a cool roof is assumed to be equal to that of a radiant barrier. There is no heating impact calculated for a cool roof (while there is some heating benefit assumed for a radiant barrier).

The benefit of a high reflectance surface is obvious: while dark surfaces absorb the sun’s energy (visible light, invisible infrared, and ultraviolet radiation) and become hot, light-colored surfaces reflect solar energy and stay cooler. However,

Answer

Forget about the 1 minute every hour. ASHRAE has issued an interpretation of the standard that says that operation such as you describe is not sufficient to use a ventilation effectiveness of 1. In this case, the fractional on-time is 0.42 (10 hours/24 hours), so ventilation effectiveness from Table 4-8 is 0.5. $Q_f = 60 \text{ cfm} / (0.42 \times 0.5) = 286 \text{ cfm}$.

Control and Operation

From ASHRAE 62.2-2007

Section 4.3 Control and Operation

The “fan on” switch on a heating or air-conditioning system shall be permitted as an operational control for systems introducing ventilation air through a duct to the return side of an HVAC system. Readily accessible override control must be provided to the occupant. Local exhaust fan switches and “fan on” switches shall be permitted as override controls. Controls, including the “fan-on” switch of a conditioning system, must be appropriately labeled.

Exception to Section 4.3: An intermittently operating, whole-house mechanical ventilation system may be used if the ventilation rate is adjusted according to the exception to §4.4. The system must be designed so that it can operate automatically based on a timer. The intermittent mechanical ventilation system must operate at least one hour out of every twelve.

The Standards require that the ventilation system have an override control which is readily accessible to the occupants. The “fan-on” switch on a typical thermostat controlling the HVAC system and the wall switch for an exhaust fan are both allowed as acceptable controls. The control must be “readily accessible”, e.g. it must be capable of being accessed quickly and easily without having to remove panels or doors. It can be as simple as a labeled wall switch by the electrical panel. It may be integrated in a labeled wall-mounted control or in the air moving device, but it cannot be buried in the insulation in the attic or the inside of the fan. The occupant must be able to modify the settings or override the system.

If intermittent fans are used, they must be controlled by a timer, and they must have an increased airflow rate to compensate for the off time.

Time-of-day timers or duty cycle timers can be used to provide intermittent whole-building ventilation. Manual crank timers cannot be used, since the system must operate automatically without intervention by the occupant. Some controls “look back” over a set time interval to see if the air handler has already operated for heating or cooling before it turns on the air handler for ventilation only operation.

Example 4-13 – Control Options**Question**

I plan to use a bathroom exhaust fan to provide whole-building ventilation for a house. The fan is designed to be operated by a typical wall switch. Do I need to put a label on the wall plate to comply with the requirement that controls be “appropriately labeled”?

Answer

Yes. If the exhaust fan were serving only the local exhaust requirement for the bathroom, then a label would not be required. Since the fan is providing the required whole-building ventilation, a label is needed to inform the occupant that the fan should be operating whenever the home is occupied.

Example 4-14 – Thermostatic Control**Question**

I plan to provide ventilation air by connecting a duct run from the return side of the central air handler to the outdoors. Ventilation will be provided whenever the air handler operates. According to my estimates, the system will run on calls for heating and cooling about 40 percent of the time, averaged over the year. If I provide a safety factor and assume that it only runs 25 percent of the time, and size the airflow accordingly, can I allow the system to run under thermostatic control?

Answer

No. A system under thermostatic control will go through periods with little or no operation when the outdoor temperature is near the indoor setpoint, or if the system is in setback mode. An intermittently operating ventilation system **MUST** be controlled by a timer in order to assure that adequate ventilation is provided regardless of outdoor conditions.

As mentioned in the text, there are timer based controls available that function to keep track of when (and for how long) the system operates to satisfy heating/cooling requirements in the home. These controls only turn on the central fan to provide additional ventilation air when heating/cooling operation of the central fan has not already operated enough to provide the required ventilation.

4.6.3 Whole-Building Mechanical Ventilation Energy Consumption

For builders using the performance compliance approach the energy use of fans (other than CFI fans) installed to meet the whole-building ventilation requirement is usually not an issue because the standard design W/CFM is set equal to the proposed design W/CFM up to an energy use level sufficient to accommodate most well designed ventilation systems. Also, the standard design whole-building ventilation system airflow rate is set equal to the proposed design whole-building ventilation system airflow rate so there is no energy penalty or credit for most systems. Systems that utilize Heat Recovery or Energy Recovery ventilators (HR/ERV) may need to account for the heat recovery benefit in the performance calculation to make up for their high energy use.

The energy use of the central air handler fan utilized for a CFI ventilation system must conform to the same fan Watt draw (W/CFM) limit as is the prescriptive requirement for cooling systems in climate zones 10-15. CFI systems are the only type of ventilation system that must meet a prescriptive fan Watt draw requirement that must be tested by the builder/installer, and verified by a HERS rater in accordance with the diagnostic test protocols given in RA3.3.

Energy use of fans installed for other purposes such as local exhaust is not regulated in the Standards.

ASHRAE 62.2) is not allowed. For airflow values not listed, use the next higher value. The table is not applicable for systems with airflow greater than 125 cfm at 0.25 inches of water column static pressure.

Table 4-9 – Prescriptive Duct Sizing for Single Fan Exhaust Systems (from 62.2, Table 7.1)

Duct Type	Flex Duct				Smooth Duct			
Fan Rating (cfm@ 0.25 in. w.c.)	50	80	100	125	50	80	100	125
Diameter inch	Maximum Length ft.							
3	X	X	X	X	5	X	X	X
4	70	3	X	X	105	35	5	X
5	NL	70	35	20	NL	135	85	55
6	NL	NL	125	95	NL	NL	NL	145
7 and above	NL	NL	NL	NL	NL	NL	NL	NL
This table assumes no elbows. Deduct 15 feet of allowable duct length for each elbow. NL = no limit on duct length of this size. X = not allowed, any length of duct of this size with assumed turns and fitting will exceed the rated pressure drop.								

Example 4-36 – Prescriptive Duct Sizing

Question

I need to provide 75 cfm of continuous ventilation, which I plan to do using a central exhaust fan. I plan to connect the fan to a roof vent termination using flex duct. The duct will be about 8 ft long, with no real elbows, but some slight bends in the duct. What size duct do I need to use?

Answer

From Table 4-9, using the 80 cfm, flex duct column, we find that the maximum length with 4 inch duct is 3 ft, so you cannot use 4 inches duct. With 5 inch duct the maximum length is 70 ft, so that will clearly be adequate. Even if the bend in the duct is treated as an elbow, the allowable length only drops to 55 ft, more than adequate for the 8 ft required.

Example 4-37

Question

For the situation in example 4-36, again providing 75 cfm, what size duct would I need if smooth metal duct were used? In this case the total length would increase to about 10 ft, and there would be 2 elbows.

Answer

Using the 80 cfm, smooth duct column of Table 4-9, we find that the maximum length of 4 inches duct is 35 ft. Subtracting 15 ft for each of the 2 elbows leaves us with 5 ft, which is not long enough. With 5 inch duct the maximum length is 135 ft. Subtracting 15 ft for each of the 2 elbows leaves us with 105 ft, so that will clearly be adequate.

Example 4-38

Question

I will need a 100 cfm range hood. I have two possible duct routings. One is 15 ft long and will require 3 elbows. The other is 35 ft long but only requires one elbow. What size flex duct do I need to use?

Answer

First, let's take the 2 routings and add in the correction for the elbows. Elbow corrections can be either added to the desired length or subtracted from the allowable length. In this case, we know the desired length, so we'll add the elbows. We get 15 ft plus 3 times 15 ft for a total of 60 ft, or 35 ft plus 15 ft equals 50 ft.

Looking at Table 4-9, in the 100 cfm, flex duct column, we find that the maximum length with 5 inches duct is 35 ft, which is less than the adjusted length for either routing. With 6 inches duct, the maximum length is 125 ft, longer than either adjusted length. 6 inch duct would need to be used for either routing. *Note:* The building code may not allow flex duct to be used for the range hood, in which case smooth duct would be required. For smooth duct, 5 inches would be acceptable.

Multi-Branch Exhaust Ducting

From ASHRAE 62.2-2007

Section 7.4 Multi-Branch Exhaust Ducting (62.2 text)

If more than one of the exhaust fans in a dwelling unit shares a common exhaust duct, each fan shall be equipped with a back-draft damper to prevent the recirculation of exhaust air from one room to another through the exhaust ducting system. Exhaust fans in separate dwelling units shall not share a common exhaust duct. Exhaust outlets from more than one dwelling unit may be served by a single exhaust fan downstream of all the exhaust inlets, if the fan is designed and intended to run continuously or if each outlet is equipped with a back-draft damper to prevent cross-contamination when the fan is not running.

ASHRAE Standard 62.2 contains restrictions on several situations where multiple exhausts are connected through a combined duct system. These restrictions are intended to prevent air from moving between spaces through the exhaust ducts.

The first restriction is that if more than one exhaust fan in a dwelling shares a common duct, then each fan must be equipped with a backdraft damper so that air exhausted from one bathroom or unit is not allowed to go into another space. Exhaust fans in multiple dwelling units may not share a common duct.

The other restriction applies to remote fans serving more than one dwelling unit. Sometimes a single remote fan or HRV/ERV will exhaust from several units in a multifamily building. This section does not preclude the use of that type of system, but it does require that either the shared exhaust fan operate continuously or that each unit be equipped with a backdraft damper so that air cannot flow from unit to unit when the fan is off.

In multifamily buildings, fire codes may impose additional restrictions.

4.6.7 Minimum Best Practice Guide: Exhaust-Only Ventilation

See [Appendix 4.A](#) for the 2008 Building Energy Efficiency Standards Residential Indoor Air Quality and Mechanical Ventilation (ASHRAE 62.2) Minimum Best Practices guide – Exhaust-Only Ventilation. The Guide can be used to demonstrate compliance with the ventilation requirements of ASHRAE 62.2 (2007) and Section 150(o) of the Standards, and can also be downloaded from the CEC website at

<http://www.energy.ca.gov/2010publications/CEC-400-2010-006/CEC-400-2010-006.PDF>

Appendix 4.A

2008 Building Energy Efficiency Standards **Residential Indoor Air Quality and Mechanical Ventilation** **(ASHRAE 62.2)**

Minimum Best Practices Guide - Exhaust-Only Ventilation

Introduction:

The California Energy Commission has created the following guide to provide assistance in complying with *ANSI/ASHRAE Standard 62.2-2007, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings (ASHRAE 62.2)*; which was adopted by reference into the *2008 Building Energy Efficiency Standards (Standards)*. *ASHRAE 62.2* was adopted to respond to concerns that reliance solely on operable windows is inadequate to provide ventilation in low-rise residential buildings. This, coupled with concerns about increasing levels of indoor contaminants and mold growth, has led to the need for mechanical ventilation.

The two main requirements of *ASHRAE 62.2* are (1) whole-building ventilation to maintain acceptable air quality, and (2) local intermittent exhaust fans in each kitchen and bathroom to reduce the levels of contaminants and moisture in these spaces.

The minimum best practices in this guide apply to residential low-rise newly constructed buildings and additions, including multi-family occupancies. The guide provides an exhaust-only approach acceptable for most residential projects needing to meet the *Standards*. Additional guidance in meeting the *Standards* may be obtained by calling the Energy Commission's *Standards* Hotline at (800) 772-3300.

Background:

The *2008 Building Energy Efficiency Standards (Standards)* require all newly constructed residential buildings to meet the requirements of *ANSI/ASHRAE Standard 62.2-2007, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings (ASHRAE 62.2)*. In California, the requirements of *ASHRAE 62.2* also apply to additions over 1,000 square feet (sf) of conditioned floor area (CFA), and window operation is not allowed as a permissible method for providing whole-building ventilation (Section 150(o) of the *Standards*).

ASHRAE 62.2 is a health and safety measure developed by the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) to enable dwellings to achieve acceptable indoor air quality. *ASHRAE 62.2* has been adopted in the *Standards* to respond to concerns that reliance solely on operable windows is inadequate to provide for ventilation in low-rise residential buildings. This, coupled with concerns about increasing levels of indoor contaminants and mold growth, has led to the need for mechanical ventilation. Implementation of these ventilation requirements will demand careful attention by builders and a focused review by enforcement agencies.

ASHRAE 62.2 specifies two mechanical ventilation airflow requirements - **Whole-Building Ventilation** and **Local Ventilation Exhaust**, and specifies criteria for prescriptive duct sizing for those ventilation systems. Other additional requirements are specified that affect indoor air quality. All applicable requirements must be met to demonstrate compliance with *ASHRAE 62.2*.

Whole-building ventilation is required to maintain acceptable air quality in a dwelling at all times. A switch is provided for controlling the operation of the fan. This allows the fan to be turned off when there are no occupants in the dwelling or when indoor air quality would be reduced when outdoor air is brought into the dwelling. The fan used for continuous ventilation must have a low sound rating in order to avoid having occupants switch off the fan to reduce the noise level. Local intermittent exhaust fans are required in all kitchens and bathrooms to reduce the level of contaminants and moisture in these spaces when they occur. These fans can be switched on and off when needed. The additional requirements are applied as applicable to the dwelling design in order to support and maintain the levels of indoor air quality provided by the whole-building and local intermittent ventilation systems.

Standards Section 10-103 requires the submittal of documentation on the building plans. Sufficient design information should be placed on the plans to demonstrate compliance with the applicable requirements of *ASHRAE 62.2* prior to issuance of a building permit. Appendix I of this guide provides sample calculations for airflow requirements and prescriptive fan and duct system sizing. Appendix II provides sample noteblocks that can be used to provide exhaust ventilation system design specifications that may be required by the enforcement agency to be included on the plans. Appendix III provides a sample Homeowner's Maintenance and Operation Form for use with this Guide. Appendix IV provides a summary checklist that may be helpful when designing a minimum best practice ventilation system.

The following minimum best practices apply to residential low-rise newly constructed buildings and additions, including multi-family occupancies. They have been developed to provide a design and construction "exhaust-only" ventilation approach acceptable for most residential projects needing to meet the *Standards*. *ASHRAE 62.2* allows compliance to be shown either through Prescriptive Ventilation System Inspection or Performance Ventilation System Testing. This guide does not include explanations for the use of other acceptable compliance alternatives in addition to "exhaust-only" ventilation, which are described in Section 4.6 of the *2008 Residential Compliance Manual*. Guidance for these other than "exhaust-only" alternative approaches, as well as additional information on the practices described below, may be obtained by calling the California Energy Commission's Energy Standards Hotline at (800) 772-3300.

Minimum Best Practices Guide

The following Minimum Best Practices Guide is a supplement to the *2008 Residential Compliance Manual* and can be used to demonstrate compliance with the ventilation requirements of *ASHRAE 62.2* and Section 150(o) of the *Standards*. The guide provides a summary of *ASHRAE 62.2* and a simplified exhaust-only approach for meeting its minimum ventilation requirements. If a statement in this Guide describes an action that must be completed for compliance with the *Standards*, there will be a box at the beginning of the statement that can be used to check off completed items, or to indicate "NA" for "not applicable" to this project for that item. An underlined blank space indicates that a value is required to be entered. When (Design) is shown adjacent to an item, that item should be considered during the design phase of the project. Appendix IV provides a summary checklist that may be helpful when designing a minimum best practice ventilation system, but does not replace the guide.

The exhaust-only ventilation approach is organized in four sets of requirements: general, whole-building ventilation, local ventilation exhaust, and other.

General Requirements:

☐ The ventilation system's design requirements are shown on the building design drawings utilizing noteblocks, sheet notes, schedules, or other means of written communication that describe the requirements for ventilation airflow, fan selection and room location, and duct sizing for Whole-Building Ventilation and Local Ventilation Exhaust. In all cases, Table 7.1 shall be placed on the plans to specify duct sizing requirements that must be met in the field to comply with *ASHRAE 62.2* exhaust-only ventilation. This makes it possible for changes to be made in the field to accommodate conditions that may not be known at the design/permit stage and still comply with the *ASHRAE 62.2* requirements. Documentation describing ventilation system controls and labeling, and other indoor air quality measures may also be required. See the sample noteblocks in Appendix II of this Guide. (Design)

☐ Prescriptive Ventilation System Inspection. Prior to final inspection, the ventilation system has been visually inspected by the contractor/installer to confirm that it meets the prescriptive duct sizing requirements and fan ratings given in Table 7.1 of *ASHRAE 62.2* (see Appendix I of this guide), and this information has been included on the Installation Certificate, (CF-6R-MECH-05);

OR

☐ Performance Ventilation System Testing. Prior to final inspection, the required minimum airflow has been confirmed by testing the delivered ventilation airflow of the installed system using a flow hood or other airflow measuring device, and this information has been included on the Installation Certificate (CF-6R-MECH-05).¹

☐ An Installation Certificate (CF-6R-MECH-05) has been completed by the builder/installer, and is posted or available at the building site for final inspection. The builder/installer signature on the CF-6R-MECH-05 for the building certifies that the building complies with the ventilation and indoor air quality requirements of the *Standards*.

Whole-Building Ventilation Requirements [*ASHRAE 62.2*, Section 4]:

Whole-Building Ventilation provides outdoor air ventilation for the entire building as contrasted with Local Ventilation Exhaust for kitchens and bathrooms, which is discussed in the next section of this guide. The most common solution for compliance using the exhaust-only approach is expected to be the installation of a quiet ceiling-mounted bathroom exhaust fan, remote-mounted inline fan, or exterior-mounted exhaust fan. Either the airflow of a single fan or the sum of the airflows from multiple fans can be used to meet the whole-building total airflow requirement.

Compliance with the *Standards* can be shown by using either the prescriptive or the performance approach. If the performance approach is used, the Indoor Air Quality (IAQ) exhaust fan system must be specified as an input to the compliance software, and that system type reported on the performance CF-1R.² For the prescriptive compliance approach, specification of the ventilation system type is not required on the CF-1R.

☐ The *ASHRAE 62.2* whole-building airflow equation 4.1a (Appendix I, item I.1) has been used to calculate the required whole-building ventilation airflow rate, and it is indicated on the

¹ Note: Although not required, measurement of the actual system airflow is the recommended way to demonstrate compliance with the requirements of both whole-building ventilation and local ventilation exhaust.

² Exhaust ventilation system type terminology may vary with the different compliance software programs.

plans. For projects using the performance method of compliance, the required whole-building airflow rate is reported on the Certificate of Compliance (CF-1R). (Design)

The required whole-building airflow rate = _____ cfm

- ☐ For additions over 1,000 sf of conditioned floor area (CFA), the whole-building ventilation airflow rate has been calculated based on the CFA of the existing dwelling plus the addition. (Design)
- ☐ The ceiling mounted whole-building ventilation fan has a sound rating of one sone or less at the required ventilation airflow rate. (Design)

Note: A remote-mounted inline fan, or exterior-mounted exhaust fan with a minimum of 4 feet of duct between the fan and intake grille, does not require a sound rating.

- ☐ The exhaust fan control(s) used for whole-building continuous operation is labeled to communicate the required continuous building ventilation function and importance with a statement to make clear how the control (e.g., on/off switch) is to be operated. At a minimum, the label should communicate: “to maintain minimum levels of outside air ventilation required for good health, the fan control should be on at all times when the building is occupied, unless there is severe outdoor air contamination.” It is recommended that the label text should be in bold type, placed on a white background, and no smaller than the equivalent of Arial 12 point type. (Design)

Sample: **To maintain minimum levels of
outside air ventilation required for
good health, the fan control should
be on at all times when the building
is occupied, unless there is severe
outdoor air contamination.**

Systems for which compliance is confirmed to meet Prescriptive Ventilation System Inspection design criteria comply with the following:

- ☐ The exhaust fan(s) used for continuous whole-building ventilation is rated by the Home Ventilation Institute (HVI)³ to provide at least the required ventilation rate at a minimum static pressure of 0.25 inches of water column (in. w.c.). (Design)
- ☐ The duct design for the whole-building ventilation system meets the requirements of Table 7.1 (Appendix I, item I.3). (Design)

Local Ventilation Exhaust Requirements [ASHRAE 62.2, Section 5]:

In addition to meeting the Whole-Building Ventilation Requirements discussed in the previous section, *ASHRAE 62.2* requires that each kitchen and bathroom have a local ventilation exhaust system installed that exhausts indoor air to outside the dwelling. The Local Ventilation Exhaust Requirements in one room can be met by a Whole-Building Ventilation exhaust system installed in that room (in this case Local Ventilation Exhaust systems would still have to be installed in other kitchens and bathrooms where the Whole-Building Ventilation exhaust system is not installed.) Use of operable windows is not allowed for meeting the local ventilation exhaust

³ To select fans that meet these criteria, use the HVI certified fan products directory at www.hvi.org.

requirements in kitchens and bathrooms. Local ventilation exhaust systems may operate intermittently or continuously according to *ASHRAE 62.2*; however, at a minimum, this Guide assumes that intermittent exhaust fan operation is used, except for the case where an exhaust fan provides both the continuous exhaust to meet the Whole-Building Ventilation System Requirements and the Local Ventilation Exhaust Requirements in one room .

- ☐ The kitchen hood(s) deliver ventilation airflow at 100 or more cfm.^{4,5} (Design)
- ☐ All bathroom exhaust fans deliver ventilation airflow at 50 or more cfm for each bathroom.⁶ (Design)
- ☐ All ceiling mounted intermittent local ventilation fans have a sound rating of three sones or less at the required airflow rate.⁷ (Design)

Note: *A remote-mounted inline fan or exterior mounted exhaust fan with a minimum of 4 feet of duct between the fan and intake grille do not require a sound rating.*

- ☐ All intermittent local ventilation exhaust fans have been designed to be operated as needed by the occupant. At a minimum, a wall switch may be used. Alternatively, some other type of control such as shut off timers, humidity sensors, or occupancy sensors may be used. (Design)

Systems for which compliance is confirmed to meet the Prescriptive Ventilation System Inspection design criteria must also comply with the following:

- ☐ All exhaust fans used for intermittent local ventilation are rated by the HVI to provide at least the required ventilation rate at a minimum static pressure of 0.25 in. w.c. (Design)
- ☐ All duct designs for intermittent local ventilation meet the requirements of Table 7.1 (Appendix I, item I.3). (Design)

Other Requirements [ASHRAE 62.2, Section 6]:

The items listed below (6.1 through 6.8) correspond to the “Other Requirements” of *ASHRAE 62.2*, Section 6, and all Section 6 requirements must be met. Other applicable *California Building Code (CBC)* requirements must also be met as noted. Refer also to Section 4.6.5 of the *2008 Residential Compliance Manual* for information describing these “Other Requirements”.

6.1. Transfer Air

Dwelling units shall be designed and constructed to provide ventilation air directly from the outdoors and not as transfer air from adjacent dwelling units or spaces, such as garages, unconditioned crawl spaces, or unconditioned attics.

Section 6.1 does not prohibit whole-building exhaust or local exhaust ventilation systems and does not require mechanical systems to maintain pressure relationships with adjacent spaces except as specified in Section 6.4.

⁴ A kitchen [for purposes of indoor air quality requirements] is any room containing cooking appliances.

⁵ Recirculating range hoods that do not exhaust pollutants to the outside cannot be used to meet the requirements of *ASHRAE 62.2*.

⁶ A bathroom [for purposes of indoor air quality requirements] is considered a room containing a bathtub, shower, spa or other similar source of moisture. Note that a room containing only a toilet is not required to meet the Local Ventilation Exhaust Requirements.

⁷ Fans that have a maximum rated airflow that exceeds 400 cfm do not require a sound rating.

- ☐ Measures consistent with the requirements of *Standards* Section 117 (Residential Compliance Manual Section 3.5) have been taken to prevent air movement between adjacent dwelling units (e.g., through party walls), and between the dwelling unit and other spaces that are either vertically or horizontally adjacent, such as garages, unconditioned crawl spaces, or unconditioned attics. All cracks, voids, and air leakage points have been filled; and all seams in plasterboard surfaces have been taped and sealed. (Design)

6.2 Instructions and Labeling

Compliance, operating, maintenance, and ventilation information on the ventilation approach being used and the expected performance of the system must be provided to the dwelling owner as specified in Section 10-103(b) of the *Standards*. This information can be in paper or electronic format.

- ☐ Compliance forms and system manuals, brochures and cut sheets, or other ventilation system information have been provided to the dwelling owner to describe proper operation and maintenance of the system, the approach being used for ventilation, the expected system performance and required actions to maintain system performance, including the Minimum Efficiency Reporting Value (MERV) filter requirements in Section 6.7 of this guide.

Note: *The ASHRAE Homeowner's Operations and Maintenance Documentation form presented in Appendix III may be used to provide some of the required information.*

Note: *The labeling requirements for the whole-building ventilation control are described in the Whole-building Ventilation Requirements section of this Guide.*

6.3 Clothes Dryers

- ☐ All clothes dryers must be exhausted directly to the outdoors (*California Mechanical Code [CMC] 905.2*). (Design)

6.4 Combustion and Solid-Fuel Burning Appliances

- ☐ Combustion and solid-fuel burning appliances are provided with adequate combustion and ventilation air, and vented in accordance with the appliance manufacturer's installation instructions and the *CMC*.
- ☐ If an atmospherically vented appliance (e.g., gas furnace or water heater), or solid fuel appliance (e.g., fireplace) is inside the building pressure boundary, the total net exhaust of the two largest exhaust fans (with both fans operating at full capacity) does not exceed 15 cfm per 100 sf of occupiable space. (Design)

6.5 Garages

- ☐ To prevent migration of contaminants from the garage to adjacent occupiable spaces, and in addition to the requirements specified in 6.1, doors between the garage and dwelling unit are gasketed and weather stripped. (Design)
- ☐ HVAC systems that include air handlers or return ducts located in the garage, have been sealed to less than 6 percent of total fan airflow and verified by a HERS rater as specified by *Standards* Section 151(f)10. (Design)

6.6 Ventilation Opening Area⁸ (for operable windows, skylights, through-the-wall-inlets, or other operable openings to the outside)

- ☐ Habitable spaces have an operable ventilation opening area equal to at least 4% of the room floor area (sf), but not less than 5 sf. For habitable spaces where it is not possible to provide the minimum Ventilation Opening Area to the outside, the opening to the adjoining rooms is unobstructed as specified in Section 1203.4.1.1. of the *CBC*, and the dwelling total operable opening area to the outdoors, based on the total occupiable floor area, meets the requirements of Section 1203.4.1 of the *CBC*. (Design)
- ☐ Toilet and utility rooms have ventilation openings with an operable area of not less than 4% of the room floor area (sf), nor less than 1.5 sf. Toilet and utility rooms that meet Local Ventilation Exhaust Requirements are not required to meet this Ventilation Opening Area requirement. Utility rooms with ducted dryer exhaust and toilet compartments in bathrooms are also not required to meet the minimum Ventilation Opening Area requirement. (Design)

6.7 Minimum Filtration

- ☐ Mechanical systems that supply air to an occupiable space through ductwork exceeding 10 feet in length and through a thermal conditioning component (e.g., heating/cooling coil) are provided with a filter having a minimum efficiency rating of MERV 6. The air filter provided is selected and sized to operate at a clean filter pressure drop no greater than 0.1 in. w.c.. The filter is installed in a manner that makes it accessible to the occupant for regular maintenance, consistent with *CMC* Section 305. (Design)
- ☐ Information describing the air filter selected for the building ventilation system, its location, maintenance, and replacement requirements are included in the compliance, operation, maintenance, and ventilation information provided to the owner according to Section 6.2 above.

6.8 Air Inlets (all operable ventilation openings)

- ☐ Any air inlets that are part of the ventilation design are located a minimum of 10 feet from known sources of contamination, such as stack, vent, exhaust hood, or vehicle exhaust. (Design)
- ☐ Ventilation openings (such as windows) are readily accessible and readily controllable by the building occupants consistent with the *CBC* (1203.4). (Design)
- ☐ Where ventilation openings are covered by louvers or are otherwise obstructed, the openable area is based on the free unobstructed area through the opening. (Design)

Note: For additional information concerning these “Other Requirements,” including any additional exceptions that may not have been covered in this Minimum Best Practice Guide, refer to the *Residential Compliance Manual* or contact the Energy Standards Hotline at (800) 772-3300.

⁸ Ventilation openings must be provided to serve as back-up ventilation if the mechanical ventilation system becomes disabled (e.g., power failure).

Appendix I: Fan and Duct Sizing Calculations

The process for exhaust-only ventilation system design is to: (1) determine the minimum amount of airflow required; (2) select a fan or multiple fans that are rated to provide ventilation airflow that equals or exceeds the minimum required; and (3) design and install a ventilation duct system that meets the requirements of *ASHRAE 62.2* Table 7.1.

(I.1) Whole-Building Ventilation Requirement Calculations

Equation 4.1a (from *ASHRAE 62.2*):

$$Q_{\text{fan}} = 0.01 \times A_{\text{floor}} + 7.5 \times (N_{\text{br}} + 1)$$

Where:

A_{floor} = conditioned floor area, ft²

N_{br} = number of bedrooms; not to be less than one

Q_{fan} = ventilation airflow requirement = minimum fan airflow rating, (cfm)

Example:

2,500 sf CFA house with 5 bedrooms

$$Q_{\text{fan}} = 0.01 \times 2500 + 7.5 \times (5 + 1) = 70 \text{ cfm}$$

(I.2) Local Ventilation Exhaust Requirement Calculations

This Minimum Best Practices Guide provides information for intermittent fan operation only for local ventilation exhaust systems. The minimum airflow rates for intermittent local ventilation exhaust are specified in Table 5.1 of *ASHRAE 62.2*. The required minimum intermittent local ventilation exhaust airflow rate for bathrooms is 50 cfm. The minimum intermittent ventilation exhaust airflow rate for kitchens is 100 cfm.

(I.3) Prescriptive Duct Sizing Calculations

Prescriptive duct sizing can be utilized to demonstrate compliance with the ventilation airflow requirement through inspection of the installed whole-building ventilation system, or local ventilation exhaust system, to confirm conformance with the requirements of Table 7.1. Instructions for the use of Table 7.1 and example calculations are provided below.

TABLE 7.1 PRESCRIPTIVE DUCT SIZING REQUIREMENTS (FROM ASHRAE 62.2)								
Duct Type	Flex Duct				Smooth Duct			
Fan Rating (cfm at 0.25 in. w.g.)	50	80	100	125	50	80	100	125
	Maximum Allowable Duct Length (ft)							
Diameter, (in)	Flex Duct				Smooth Duct			
3	X	X	X	X	5	X	X	X
4	70	3	X	X	105	35	5	X
5	NL	70	35	20	NL	135	85	55
6	NL	NL	125	95	NL	NL	NL	145
7 and above	NL	NL	NL	NL	NL	NL	NL	NL
<p>This table assumes no elbows. Deduct 15 ft of allowable duct length for each turn, elbow, or fitting. Interpolation and extrapolation in Table 7.1 is not allowed. For fan rating values not listed, use the next higher value. This table is not applicable for fan ratings > 125 cfm.</p> <p>NL = no limit on duct length of this size.</p> <p>X = not allowed, any length of duct of this size with assumed turns and fittings will exceed the rated pressure drop (0.25 in w.g.).</p> <p>Note: water gauge (w.g.) is the same as water column (w.c.)</p>								

- Determine the duct material that will be used for the installation (smooth or flex). Duct sizing will use the Table 7.1 columns under the selected type of duct.
- Identify the fan rating(s) used to provide whole-building and local ventilation exhaust (cfm).
- Select the column that corresponds to the required fan rating for the system. If the required fan rating (airflow cfm) is not shown on the chart and falls between columns, use the next highest fan rating column for determining the duct length and diameter. The Table is not applicable to fan ratings greater than 125 cfm.
- Select the preferred duct diameter to determine the corresponding maximum allowable duct length from the fan rating column for each exhaust fan. For each turn, elbow or fitting in the duct run, subtract 15 feet of length from the allowable duct length specified in the Table. If the allowable length of (straight) duct is not sufficient for the design, select the next higher diameter of duct, and recalculate the allowance. An "NL" in the table indicates that any length of duct for that diameter is in compliance.

Examples:

Example 1: For a 50 cfm fan using 4" flex duct, the length can be a maximum of 70 feet (ft) of straight duct without elbows.

Example 2: For an 80 cfm fan using 4" flex duct, the length would be limited to 3 ft of straight duct without elbows.

Example 3: For the Equation 4.1a example shown above in Appendix I, item I.1, assume smooth duct will be used, there will be 3 elbows, and there is 40 ft. of straight duct required to run a duct from the fan to the exterior of the building. The determined fan rating (70 cfm) is not on the chart, so use the next highest column that is greater than 70 cfm – use the 80 cfm column. Since the system requires 3 elbows, 45 ft. must be subtracted from the values in the table. For smooth ducts in the 80 cfm column, 4-inch duct has a maximum allowable duct length of 35 ft. (too short). 5-inch duct has an allowable straight length of 135 ft. from which the allowance for elbows ($3 \times 15 = 45$ ft) must be subtracted ($135 - 45 = 90$ ft.). Since the allowable length (90 ft.) is greater than the required length (40 ft) this combination of duct material, duct diameter, duct length and number of elbows meets the Table 7.1 duct sizing requirement.

Appendix II: Sample Noteblocks

Noteblocks, sheet notes, schedules or other forms of written communication that specify the requirements for ventilation airflow, the rooms where the whole-building and local ventilation exhaust fans are located, and duct sizing for Whole-Building Ventilation and Local Ventilation exhaust shall be specified on the plans submitted to the enforcement agency for a building permit. However, in all cases, Table 7.1 shall be placed on the plans to allow for duct changes that may be required during construction of the system.

The following sample noteblocks may be placed on the building design plans to meet the requirements for submittal of the ventilation system specifications to the enforcement agency.

WHOLE-BUILDING VENTILATION REQUIREMENTS (FROM ASHRAE 62.2)		
AT LEAST ONE MECHANICAL VENTILATION SYSTEM IN THE BUILDING MUST BE DESIGNATED FOR USE IN COMPLIANCE WITH THE WHOLE-BUILDING VENTILATION REQUIREMENT. ALTERNATIVELY, THE SUM OF THE RATED AIRFLOWS FROM MULTIPLE FANS CAN BE UTILIZED TO MEET THE REQUIRED WHOLE-BUILDING VENTILATION AIRFLOW. THE SYSTEM(S) MUST DELIVER CONTINUOUS VENTILATION AIRFLOW AT A RATE GREATER THAN OR EQUAL TO THE RATE SPECIFIED IN EQUATION 4.1 a, AND FAN SONE RATINGS MUST NOT EXCEED 1.0. FOR DWELLING OCCUPANT DENSITIES KNOWN TO BE GREATER THAN ($N_{BR} + 1$), THE RATE SHALL BE INCREASED BY 7.5 CFM FOR EACH ADDITIONAL PERSON.		
(Eq. 4.1a) $Q_{fan} = 0.01A_{floor} + 7.5(N_{br} + 1)$	Where: A_{floor} = conditioned floor area, ft^2 N_{br} = number of bedrooms; not to be less than one Q_{fan} = ventilation air requirement = fan flow rate, (cfm)	Eq 4.1a Calculation: $A_{floor} =$ $N_{br} =$ $Q_{fan} =$

LOCAL VENTILATION EXHAUST REQUIREMENTS (FROM ASHRAE 62.2)		
LOCAL MECHANICAL EXHAUST FANS SHALL BE INSTALLED IN EACH KITCHEN AND BATHROOM ACCORDING TO THE REQUIREMENTS OF ASHRAE 62.2. THE MINIMUM AIRFLOW RATES SHALL BE GREATER THAN OR EQUAL TO THE AMOUNT INDICATED IN TABLE 5.1 BELOW AND FAN SONE RATINGS MUST NOT EXCEED 3.0.		
TABLE 5.1 MINIMUM INTERMITTENT LOCAL VENTILATION EXHAUST AIRFLOW RATES		
APPLICATION	AIRFLOW	NOTES
KITCHEN	100 CFM	VENTED RANGE HOOD REQUIRED IF EXHAUST FAN FLOW IS LESS THAN 5 ACH.* IF THE RANGE HOOD IS USED FOR LOCAL EXHAUST IT MUST BE VENTED TO THE OUTDOORS
BATHROOM	50 CFM	

* Air Changes per Hour (ACH), which is determined by multiplying the volume of the space by five (5) ACH = cubic feet per hour, and then dividing by 60 minutes per hour to determine the cubic feet per minute (cfm).

PRESCRIPTIVE DUCT SIZING REQUIREMENTS (FROM ASHRAE 62.2)

IN ORDER TO COMPLY WITH THE PRESCRIPTIVE DUCT SIZING REQUIREMENTS OF ASHRAE 62.2, A VENTILATION FAN MUST BE SELECTED THAT IS RATED TO PROVIDE AT A MINIMUM THE REQUIRED VENTILATION AIRFLOW AT 0.25 IN. W.G. AND THE DUCTS MUST BE SIZED IN ACCORDANCE WITH THE SPECIFICATIONS GIVEN IN TABLE 7.1, BELOW.

TABLE 7.1

Duct Type	Flex Duct				Smooth Duct			
Fan Rating (cfm at 0.25 in. w.g.)	50	80	100	125	50	80	100	125
	Maximum Allowable Duct Length (ft)							
Diameter, (in)	Flex Duct				Smooth Duct			
3	X	X	X	X	5	X	X	X
4	70	3	X	X	105	35	5	X
5	NL	70	35	20	NL	135	85	55
6	NL	NL	125	95	NL	NL	NL	145
7 and above	NL	NL	NL	NL	NL	NL	NL	NL

This table assumes no elbows. Deduct 15 ft of allowable duct length for each turn, elbow, or fitting. Interpolation and extrapolation in Table 7.1 is not allowed. For fan ratings not listed, use the next higher value. This table is not applicable for fan ratings > 125 cfm.
 NL = no limit on duct length of this size.
 X = not allowed, any length of duct of this size with assumed turns and fittings will exceed the rated pressure drop (0.25 in w.g.)
 Note: water gauge (w.g.) is the same as water column (w.c.)

OTHER REQUIREMENTS FOR INDOOR AIR QUALITY (FROM ASHRAE 62.2)

THE BUILDING MUST COMPLY WITH THE "OTHER REQUIREMENTS" SPECIFIED IN ASHRAE 62.2 SECTIONS 6.1 THROUGH 6.8.

- 6.1 TRANSFER AIR
- 6.2 INSTRUCTIONS AND LABELING
- 6.3 CLOTHES DRYERS
- 6.4 COMBUSTION AND SOLID-FUEL BURNING APPLIANCES
- 6.5 GARAGES
- 6.6 VENTILATION OPENING AREA
- 6.7 MINIMUM FILTRATION
- 6.8 AIR INLETS

Appendix III: Homeowner's Operations and Maintenance Documentation Form

(ASHRAE 62.2)

HOMEOWNERS OPERATIONS AND MAINTENANCE DOCUMENTATION FORM

Installer Information:

Company Name _____ Date Installed: _____

Address _____ Date Serviced: _____

_____ Date Serviced: _____

_____ Date Serviced: _____

Phone: _____ Date Serviced: _____

Whole-Building Ventilation System Type: _____

Whole-Building Ventilation Operating Instructions and Schedule: _____

Required Maintenance (annual or seasonal recommended as a minimum):

Ventilation Equipment and/or Devices:

Equipment

Model

Manufacturer

Phone: _____

Phone: _____

Phone: _____

Phone: _____

Phone: _____

Phone: _____

Appendix IV: Summary Checklist for ASHRAE 62.2 Minimum Best Practices Guide Exhaust-Only Ventilation

General Requirements:

- ☐ Design requirements shown on building design drawings
- ☐ Compliance with the ventilation airflow requirements demonstrated by:
 - ☐ Prescriptive Ventilation System Inspection. Visually inspecting prescriptive duct sizing and fan ratings
- OR
- ☐ Performance Ventilation System Testing. Testing to confirm the delivery of the minimum ventilation airflow
- ☐ Complete, sign and make an Installation Certificate (CF-6R-MECH-05) available at the site

Whole-Building Ventilation:

- ☐ Whole-building exhaust ventilation system meets the required whole-building ventilation airflow, which is _____ cfm
- ☐ Whole-building exhaust fan(s) has a sound rating of one sone or less at the required ventilation airflow rate
- ☐ Whole-building exhaust fan control(s) is labeled as to function and importance
For systems complying with the Prescriptive Ventilation System Inspection requirements:
- ☐ Whole-building exhaust fan(s) is rated to provide at least the minimum ventilation rate at a minimum static pressure of 0.25" w.c.
- ☐ Whole-building ventilation duct design meets requirements of Table 7.1

Local Ventilation Exhaust:

- ☐ Kitchen hood delivers ventilation airflow of at least 100 cfm
- ☐ Kitchen fan(s) exhausted to exterior
- ☐ All bathroom exhaust fans deliver ventilation airflow of at least 50 cfm for each bathroom
- ☐ All local exhaust fans have a sound rating of three sones or less at the required ventilation airflow rate
- ☐ All intermittent local exhaust fans have been designed to be operated as needed by the occupant (such as wall switch, shut-off timer, humidistat or occupancy sensor)
For systems complying with the Prescriptive Ventilation System Inspection requirements:
- ☐ All local exhaust fans are rated to provide at least the minimum ventilation rate at a minimum static pressure of 0.25" w.c.
- ☐ All local ventilation duct designs meet the requirements of Table 7.1

Other Requirements:

6.1 Transfer Air

- ☐ Measures have been taken to prevent air movement between dwelling units and between dwelling units and other adjacent spaces.

6.2 Instructions and Labeling

- ☐ Compliance forms and information describing the approach, operation, maintenance and expected performance of the ventilation system has been provided to the owner.

6.3 Clothes Dryers

- ☐ All clothes dryers are exhausted directly to the outdoors.

6.4 Combustion and Solid-Fuel Burning Appliances

- ☐ If atmospherically-vented or solid-fuel appliances are inside the building pressure boundary, the total net exhaust of the two largest exhaust fans (at full capacity) does not exceed 15 cfm per 100 sf of occupiable space.

6.5 Garages

- ☐ In addition to 6.1, doors between garage and dwelling unit must be gasketed and weather stripped.
- ☐ HVAC systems with air handlers or return ducts in the garage are sealed to less than 6% leakage of total fan airflow and verified by HERS rater.

6.6 Ventilation Opening Area (for operable windows, skylights, through-the-wall-inlets, or other operable openings to the outside)

- ☐ Habitable spaces have a ventilation opening area no less than 4% of room floor area nor less than 5 sf.
- ☐ Toilet and utility rooms not meeting local exhaust ventilation requirements have operable window area no less than 4% of room floor area nor less than 1.5 sf.

6.7 Minimum Filtration

- ☐ Mechanical systems supplying air to occupiable space through a thermal conditioning component (e.g., heating/cooling coil) and with duct run greater than 10 ft must have a filter:
 - ☐ With a minimum efficiency of MERV 6.
 - ☐ Sized to operate with a clean filter pressure drop no greater than 0.1" w.c.
 - ☐ Information provided to owner that describes filter location, maintenance and replacement requirements.

6.8 Air Inlets (all operable ventilation openings)

- ☐ Any air inlets that are part of the ventilation system are located a minimum of 10 ft away from known sources of contamination (e.g., stack, vent, exhaust hood, or vehicle exhaust).
- ☐ Ventilation openings are readily accessible and controllable by occupant.
- ☐ Where ventilation openings are covered or obstructed, the openable area is based on the free, unobstructed area through the opening.

CERTIFICATE OF FIELD VERIFICATION AND DIAGNOSTIC TESTING		CF-4R-MECH-25
Refrigerant Charge Verification - Standard Measurement Procedure		(Page 2 of 5)
Site Address:	Enforcement Agency:	Permit Number:

Standard Charge Measurement Procedure (for use if outdoor air dry-bulb is above 55 °F)

Procedures for determining Refrigerant Charge using the Standard Charge Measurement Procedure are available in Reference Residential Appendix RA3.2. As many as 4 systems in the dwelling can be documented for compliance using this form. Attach an additional form(s) for any additional systems in the dwelling as applicable.

- The system should be installed and charged in accordance with the manufacturer's specifications before starting this procedure.
- The system must meet minimum airflow requirements as prerequisite for a valid refrigerant charge test.
- If outdoor air dry-bulb is 55 °F or below, the installer must use the RA3.2.3 Alternate Charge Measurement Procedure (Weigh-In Charging Method). If the Weigh-In Method is used, the dwelling cannot be included in a sample group for HERS verification compliance.

Space Conditioning Systems

System Name or Identification/Tag				
System Location or Area Served				
Outdoor Unit Serial #				
Outdoor Unit Make				
Outdoor Unit Model				
Nominal Cooling Capacity (ton)				
Date of Verification				

Calibration of Diagnostic Instruments

Date of Refrigerant Gauge Calibration		(must be re-calibrated monthly)
Date of Thermocouple Calibration		(must be re-calibrated monthly)

Measured Temperatures (°F)

System Name or Identification/Tag				
Supply (evaporator leaving) air dry-bulb temperature ($T_{\text{supply, db}}$)				
Return (evaporator entering) air dry-bulb temperature ($T_{\text{return, db}}$)				
Return (evaporator entering) air wet-bulb temperature ($T_{\text{return, wb}}$)				
Evaporator saturation temperature ($T_{\text{evaporator, sat}}$)				
Condensor saturation temperature ($T_{\text{condensor, sat}}$)				
Suction line temperature (T_{suction})				
Liquid Line Temperature (T_{liquid})				
Condenser (entering) air dry-bulb temperature ($T_{\text{condenser, db}}$)				

INSTALLATION CERTIFICATE		CF-6R-MECH-25-HERS
Refrigerant Charge Verification - Standard Measurement Procedure		(Page 2 of 5)
Site Address:	Enforcement Agency:	Permit Number:

Standard Charge Measurement Procedure (for use if outdoor air dry-bulb is above 55 °F)

Procedures for determining Refrigerant Charge using the Standard Charge Measurement Procedure are available in Reference Residential Appendix RA3.2. As many as 4 systems in the dwelling can be documented for compliance using this form. Attach an additional form(s) for any additional systems in the dwelling as applicable.

- *The system should be installed and charged in accordance with the manufacturer's specifications before starting this procedure.*
- *The system must meet minimum airflow requirements as prerequisite for a valid refrigerant charge test.*
- *If outdoor air dry-bulb is 55 °F or below, the installer must use the RA3.2.3 Alternate Charge Measurement Procedure (Weigh-In Charging Method). If the Weigh-In Method is used, the dwelling cannot be included in a sample group for HERS verification compliance.*

Space Conditioning Systems

System Name or Identification/Tag				
System Location or Area Served				
Outdoor Unit Serial #				
Outdoor Unit Make				
Outdoor Unit Model				
Nominal Cooling Capacity (ton)				
Date of Verification				

Calibration of Diagnostic Instruments

Date of Refrigerant Gauge Calibration		(must be re-calibrated monthly)
Date of Thermocouple Calibration		(must be re-calibrated monthly)

Measured Temperatures (°F)

System Name or Identification/Tag				
Supply (evaporator leaving) air dry-bulb temperature (T _{supply, db})				
Return (evaporator entering) air dry-bulb temperature (T _{return, db})				
Return (evaporator entering) air wet-bulb temperature (T _{return, wb})				
Evaporator saturation temperature (T _{evaporator, sat})				
Condensor saturation temperature (T _{condensor, sat})				
Suction line temperature (T _{suction})				
Liquid Line Temperature (T _{liquid})				
Condenser (entering) air dry-bulb temperature (T _{condenser, db})				

Simplified Prescriptive Certificate of Compliance: 2008 Residential HVAC CF-1R-ALT-HVAC

Climate Zones 2, 9

Site Address:		Enforcement Agency:		Date:	Permit #:
Equipment Type¹	List Minimum Efficiency²		Conditioned Floor Area	Duct insulation requirement	Thermostat
<input type="checkbox"/> Packaged Unit <input type="checkbox"/> Furnace <input type="checkbox"/> Indoor Coil <input type="checkbox"/> Condensing Unit <input type="checkbox"/> Other _____	<input type="checkbox"/> AFUE _____ <input type="checkbox"/> SEER _____ <input type="checkbox"/> EER _____	<input type="checkbox"/> COP _____ <input type="checkbox"/> HSPF _____ <input type="checkbox"/> Resistance _____	Served by system _____ sf	Over 40 ft of ducts added or replaced in unconditioned space <input type="checkbox"/> R 6 (CZ 2 and 9)	<input type="checkbox"/> Setback <i>(If not already present, must be installed)</i>
1. Equipment Type: Choose the equipment being installed; if more than one system, use another CF-1R-ALT-HVAC for each system. 2. Minimum Equipment Efficiencies: 13 SEER, 78% AFUE, 7.7HSPF for typical residential systems.					
HERS VERIFICATION SUMMARY Listed below are four HVAC alteration Options. The installer decides what work is being done and picks one of the appropriate Options. Each Option lists the HERS measures that must be conducted. A copy of the forms shall be left on site for final inspection and a copy given to the homeowner. At final, the inspector verifies that the work listed on this form was in fact the work completed by the installer. The inspector also verifies that each appropriate CF-6R and registered CF-4R forms (no hand filled CF-4Rs allowed) are filled out and signed. Beginning October 1, 2010, a registered copy of the CF-1R and CF-6R shall also be on site for final inspection.					
<input type="checkbox"/> 1. HVAC Changeout		Required Forms:			
<ul style="list-style-type: none"> All HVAC Equipment replaced 		CF-6R forms: MECH-04, MECH-21-HERS and (for split systems) MECH-25-HERS CF-4R forms: MECH-21 and (for split systems) MECH-25			
<ul style="list-style-type: none"> Condenser Coil and /or Indoor Coil and /or Furnace 		CF-6R forms: MECH-21-HERS and (for split systems) MECH-25-HERS CF-4R forms: MECH-21 and (for split systems) MECH-25			
For Split Systems: Duct leakage < 15 percent; RC, CCA ≥ 300 CFM/ton, TMAH For Packaged Units: Duct leakage < 15 percent Exempted from duct leakage testing if: <input type="checkbox"/> 1. Duct system was documented to have been previously sealed and confirmed through HERS verification, or <input type="checkbox"/> 2. Duct systems with less than 40 linear feet in unconditioned space, or <input type="checkbox"/> 3. Existing duct systems are constructed, insulated or sealed with asbestos					
<input type="checkbox"/> 2. New HVAC System		Required Forms:			
<ul style="list-style-type: none"> Cut in or Changeout with new ducts: (all new ducting and all new equipment) 		CF-6R forms: MECH-04, MECH-20-HERS and (for split systems) MECH-25-HERS CF-4R forms: MECH-20 and (for split systems) MECH-25			
For Split Systems: Duct leakage < 6 percent; RC, CCA ≥ 300 CFM/ton, TMAH. For Packaged Units: Duct leakage < 6 percent					
<input type="checkbox"/> 3. New Ducts with Replacement		Required Forms:			
<ul style="list-style-type: none"> Includes replacing or installing all new ducting and/or outdoor condensing unit and/or indoor coil and/or furnace. Not all equipment changed. 		CF-6R forms: MECH-04, MECH-20-HERS, and (for split systems) MECH-25-HERS CF-4R forms: MECH-20 and (for split systems) MECH-25			
For Split Systems: Duct leakage < 6 percent, RC, CCA ≥ 300 CFM/ton, TMAH For Packaged Units: Duct leakage < 6 percent					
<input type="checkbox"/> 4. New Ducting over 40 feet		Required Forms:			
<ul style="list-style-type: none"> Includes adding or replacing more than 40 linear feet of duct in unconditioned space. 		CF-6R forms: MECH-04, MECH-21-HERS CF-4R forms: MECH-21			
For split system or packaged units: Duct leakage < 15 percent <input type="checkbox"/> EXCEPTION: Existing duct systems constructed, insulated or sealed with asbestos.					
Contractor (Documentation Author's /Responsible Designer's Declaration Statement) <ul style="list-style-type: none"> I certify that this Certificate of Compliance documentation is accurate and complete. I am eligible under Division 3 of the California Business and Professions Code to accept responsibility for the design identified on this Certificate of Compliance. I certify that the energy features and performance specifications for the design identified on this Certificate of Compliance conform to the requirements of Title 24, Parts 1 and 6 of the California Code of Regulations. The design features identified on this Certificate of Compliance are consistent with the information documented on other applicable compliance forms, worksheets, calculations, plans and specifications submitted to the enforcement agency for approval with the permit application. 					
Name:			Signature:		
Company:				Date:	
Address:				License:	
City/State/Zip:				Phone:	

Site Address:		Enforcement Agency:		Date:	Permit #:
Equipment Type ¹	List Minimum Efficiency ²		Duct insulation requirement	Conditioned Floor Area	Thermostat
<input type="checkbox"/> Packaged Unit <input type="checkbox"/> Furnace <input type="checkbox"/> Indoor Coil <input type="checkbox"/> Condensing Unit <input type="checkbox"/> Other	<input type="checkbox"/> AFUE _____ <input type="checkbox"/> SEER _____ <input type="checkbox"/> EER _____	<input type="checkbox"/> COP _____ <input type="checkbox"/> HSPF _____ <input type="checkbox"/> Resistance _____	Over 40 ft of ducts added or replaced in unconditioned space <input type="checkbox"/> R 6 (CZ 10-13) <input type="checkbox"/> R 8 (CZ 14-15)	Served by system _____ sf	<input type="checkbox"/> Setback <i>(If not already present, must be installed)</i>
1. Equipment Type: Choose the equipment being installed; if more than one system, use another CF-1R-ALT-HVAC for each system. 2. Minimum Equipment Efficiencies: 13 SEER, 78% AFUE, 7.7HSPF for typical residential systems.					
HERS VERIFICATION SUMMARY Listed below are four HVAC alteration Options. The installer decides what work is being done and picks one of the appropriate Options. Each Option lists the HERS measures that must be conducted. A copy of the forms shall be left on site for final inspection and a copy given to the homeowner. At final, the inspector verifies that the work listed on this form was in fact the work completed by the installer. The inspector also verifies that each appropriate CF-6R and registered CF-4R forms (no hand filled CF-4Rs allowed) are filled out and signed. Beginning October 1, 2010, a registered copy of the CF-1R and CF-6R shall also be on site for final inspection.					
<input type="checkbox"/> 1. HVAC Changeout		Required Forms:			
<ul style="list-style-type: none"> All HVAC Equipment replaced 		CF-6R forms: MECH-04, MECH-21-HERS and (for split systems) MECH-25-HERS CF-4R forms: MECH-21 and (for split systems) MECH-25			
<ul style="list-style-type: none"> Condenser Coil and /or Indoor Coil and /or Furnace 		CF-6R forms: MECH-21-HERS and (for split systems) MECH- 25-HERS CF-4R forms: MECH-21 and (for split systems) MECH-25			
For Split Systems: Duct leakage < 15 percent; RC, CCA ≥ 300 CFM/ton (Minimum Air Flow Requirement), TMAH For Packaged Units: Duct leakage < 15 percent Exempted from duct leakage testing if: <input type="checkbox"/> 1. Duct system was documented to have been previously sealed and confirmed through HERS verification, or <input type="checkbox"/> 2. Duct systems with less than 40 linear feet in unconditioned space, or <input type="checkbox"/> 3. Existing duct systems are constructed, insulated or sealed with asbestos					
<input type="checkbox"/> 2. New HVAC System		Required Forms:			
<ul style="list-style-type: none"> Cut in or Changeout with new ducts: (all new ducting <u>and</u> all new equipment) 		CF-6R forms: MECH-04, MECH-20-HERS, and (for split systems) MECH-22-HERS, and MECH-25-HERS CF-4R forms: MECH-20, and (for split systems) MECH-22, and MECH-25			
For Split Systems: Duct leakage < 6 percent; RC, CCA ≥ 350 CFM/ton, FWD, TMAH, STMS, and either HSPP or PSPP. For Packaged Units: Duct leakage < 6 percent					
<input type="checkbox"/> 3. New Ducts with Replacement		Required Forms:			
<ul style="list-style-type: none"> Includes replacing or installing all new ducting and/or outdoor condensing unit and/or indoor coil and/or furnace. Not all equipment changed. 		CF-6R forms: MECH-04, MECH-20-HERS, and (for split systems) MECH-25-HERS CF-4R forms: MECH-20 and (for split systems) MECH-25			
For Split Systems: Duct leakage < 6 percent, RC, CCA ≥ 300 CFM/ton, TMAH For Packaged Units: Duct leakage < 6 percent					
<input type="checkbox"/> 4. New Ducting over 40 feet		Required Forms:			
<ul style="list-style-type: none"> Includes adding or replacing more than 40 linear feet of duct in unconditioned space. 		CF-6R forms: MECH-04, MECH-21-HERS		CF-4R forms: MECH-21	
For split system or packaged units: Duct leakage < 15 percent <input type="checkbox"/> EXCEPTION: Existing duct systems constructed, insulated or sealed with asbestos.					
Contractor (Documentation Author's/Responsible Designer's Declaration Statement)					
<ul style="list-style-type: none"> I certify that this Certificate of Compliance documentation is accurate and complete. I am eligible under Division 3 of the California Business and Professions Code to accept responsibility for the design identified on this Certificate of Compliance. I certify that the energy features and performance specifications for the design identified on this Certificate of Compliance conform to the requirements of Title 24, Parts 1 and 6 of the California Code of Regulations. The design features identified on this Certificate of Compliance are consistent with the information documented on other applicable compliance forms, worksheets, calculations, plans and specifications submitted to the enforcement agency for approval with the permit application. 					
Name:			Signature:		
Company:			Date:		
Address:			License:		
City/State/Zip:			Phone:		

Simplified Prescriptive Certificate of Compliance: 2008 Residential HVAC CF-1R-ALT-HVAC**Climate Zones 16**

Site Address:		Enforcement Agency:		Date:	Permit #:
Equipment Type¹	List Minimum Efficiency²		Conditioned Floor Area	Duct insulation requirement	Thermostat
<input type="checkbox"/> Packaged Unit <input type="checkbox"/> Furnace <input type="checkbox"/> Indoor Coil <input type="checkbox"/> Condensing Unit <input type="checkbox"/> Other _____	<input type="checkbox"/> AFUE _____ <input type="checkbox"/> SEER _____ <input type="checkbox"/> EER _____	<input type="checkbox"/> COP _____ <input type="checkbox"/> HSPF _____ <input type="checkbox"/> Resistance _____	Served by system _____ sf	Over 40 ft of ducts added or replaced in unconditioned space <input type="checkbox"/> R 8 (CZ 16)	<input type="checkbox"/> Setback <i>(If not already present, must be installed)</i>
1. Equipment Type: Choose the equipment being installed; if more than one system, use another CF-1R-ALT-HVAC for each system. 2. Minimum Equipment Efficiencies: 13 SEER, 78% AFUE, 7.7HSPF for typical residential systems.					
HERS VERIFICATION SUMMARY Listed below are four HVAC alteration Options. The installer decides what work is being done and picks one of the appropriate Options. Each Option lists the HERS measures that must be conducted. A copy of the forms shall be left on site for final inspection and a copy given to the homeowner. At final, the inspector verifies that the work listed on this form was in fact the work completed by the installer. The inspector also verifies that each appropriate CF-6R and registered CF-4R forms (no hand filled CF-4Rs allowed) are filled out and signed. Beginning October 1, 2010, a registered copy of the CF-1R and CF-6R shall also be on site for final inspection.					
<input type="checkbox"/> 1. HVAC Changeout		Required Forms:			
<ul style="list-style-type: none"> All HVAC Equipment replaced 		CF-6R forms: MECH-04 and MECH-21-HERS CF-4R forms: MECH-21			
<ul style="list-style-type: none"> Condenser Coil and /or Indoor Coil and /or Furnace 		CF-6R forms: MECH-21-HERS CF-4R forms: MECH-21			
For Split Systems: Duct leakage < 15 percent For Packaged Units: Duct leakage < 15 percent Exempted from duct leakage testing if: <input type="checkbox"/> 1. Duct system was documented to have been previously sealed and confirmed through HERS verification, or <input type="checkbox"/> 2. Duct systems with less than 40 linear feet in unconditioned space, or <input type="checkbox"/> 3. Existing duct systems are constructed, insulated or sealed with asbestos					
<input type="checkbox"/> 2. New HVAC System		Required Forms:			
<ul style="list-style-type: none"> Cut in or Changeout with new ducts: (all new ducting <u>and</u> all new equipment) 		CF-6R forms: MECH-04 and MECH-20-HERS CF-4R forms: MECH-20			
For Split Systems: Duct leakage < 6 percent, For Packaged Units: Duct leakage < 6 percent					
<input type="checkbox"/> 3. New Ducts with Replacement		Required Forms:			
<ul style="list-style-type: none"> Includes replacing or installing all new ducting and/or outdoor condensing unit and/or indoor coil and/or furnace. Not all equipment changed. 		CF-6R forms: MECH-04 and MECH-20-HERS CF-4R forms: MECH-20			
For Split Systems: Duct leakage < 6 percent For Packaged Units: Duct leakage < 6 percent					
<input type="checkbox"/> 4. New Ducting over 40 feet		Required Forms:			
<ul style="list-style-type: none"> Includes adding or replacing more than 40 linear feet of duct in unconditioned space. 		CF-6R forms: MECH-04 and MECH-21-HERS CF-4R forms: MECH-21			
For split system or packaged units: Duct leakage < 15 percent <input type="checkbox"/> EXCEPTION: Existing duct systems constructed, insulated or sealed with asbestos.					
Contractor (Documentation Author's /Responsible Designer's Declaration Statement) <ul style="list-style-type: none"> I certify that this Certificate of Compliance documentation is accurate and complete. I am eligible under Division 3 of the California Business and Professions Code to accept responsibility for the design identified on this Certificate of Compliance. I certify that the energy features and performance specifications for the design identified on this Certificate of Compliance conform to the requirements of Title 24, Parts 1 and 6 of the California Code of Regulations. The design features identified on this Certificate of Compliance are consistent with the information documented on other applicable compliance forms, worksheets, calculations, plans and specifications submitted to the enforcement agency for approval with the permit application. 					
Name:			Signature:		
Company:				Date:	
Address:				License:	
City/State/Zip:				Phone:	